results on the eighteen types of wing which formed the models experimented on, there is no special type which can be said to be the most advantageous from the aeroplane constructor's point of view, and the choice of the most advantageous depends upon the conditions of the particular problem in each case. In the case of wings with reverse curvature it was found that the reaction was no longer proportional to the square of the velocities. The wings tested had sections similar to those employed by the principal designers of aeroplanes.

Propellers were tested by driving them by an electric motor in the wind tunnel; thus the results obtained more closely conform to the conditions of flight, and the "dynamic" instead of the "static" thrust is obtained. The conclusions to be drawn from the experiments are that the reaction upon a propeller cannot be assumed exactly proportional to the square of the relative velocity, and from a study of the model it is possible to predict all the elements of propeller action provided that the model be tested with the same relative velocity, both in magnitude and direction, that the full-sized propeller is expected to use. This requires for the same velocity of translation a speed of rotation inversely proportional to the diameters of model and propeller. The distortion of the propeller at high velocities is mentioned as a cause of some variations observed in the results. Velocities of 5 to 18 metres per second were used, and the propellers were driven at speeds from 400 to 1600 revolutions per minute.

By such experiments facts are being brought to light which already have had a great influence on aeroplane construction in France, and the experiments on models offer a safe guide to the behaviour of the air upon aeroplane wings by the use of appropriate constants. From the results of the experiments the minimum effective power that can sustain flight is obtained for a given wing section. Thus a Blériot machine with a supporting area of 25 sq. metres, weight in service with pilot 588 kg., and an angle of attack of 9°, was found by the model to require a minimum effective power of 24 h.p. This, it is stated, is practically the power used. The effect of superposed planes is also studied; also the effect of aspect ratio upon the reaction. In this connection it may be mentioned that the author first observed the curious variations for a square plate with the Eiffel Tower dropping apparatus. The reaction on a square plate inclined 37° is nearly one and one-half times the reaction when normal to the wind. With good judgment the translator has retained the metric units.

R. S. B.

OUR BOOKSHELF.

Ulster Folklore. By Elizabeth Andrews. Pp. xiii + 121 + xii plates. (London: Elliot Stock, 1913.) Price 5*s.* net.

This dainty volume is made up of a collection of papers communicated to various societies and journals. As much of the information was collected at first hand, the book is a valuable contribution to the literature of Irish folklore. The expressed purpose kept in view was to find, and show, some correspondence between the description of Irish fairies and that of actual pigmies found, dead and alive, in various parts of the world, and that purpose gives unity to the work, which is more of a monograph than a folklore drag-net. The correspondence made out is certainly very striking. There are also rare pigmies to be met with in Ireland as well as elsewhere. But of the actual existence of pigmy communities in Ireland no evidence is given. The fairies there, as elsewhere, haunt "raths and souterrains." They occupy Neolithic megalithic structures. The photographs, plans, and descriptions of some fairy souterrains give the work special value. One recognises the invariably oriented creepway. Only on one plan the north point is marked, that of Knockdhu (p. 30). If the true north is given, the cove, which is 87 ft. long, is oriented 70° N.W.–S.E. The entrance is south-east; and assuming a sky-line elevation of one degree, the star Antares is indicated about 1700 B.C., a date by no means late for a Neolithic culture in the north of Ireland.

There is some evidence to show "that Palæolithic man lived and worked in Ireland" (pp. 99–100). "It is difficult to exterminate a people, and they could not be driven further west" (p. 104). One may add that the pigmy of folklore is much more ancient than the Irish Neolithic men. In the case of Ireland, however, what may be said with tolerable certainty is that the fairies are the Neolithic builders, and the case is well stated in a quoted statement of the late Mr. John Gray. "The stature of these primitive Danes and Pechts is five feet three inches, and they must have looked very small men to the later Teutonic invaders of an average stature of five feet eight and a half inches" (p. 102). The souterrains of Ardtole and Maghera are 5 ft. 3 in. high.

John Griffith.

Chemistry: Inorganic and Organic, with Experiments. By C. L. Bloxam. Tenth edition, Rewritten and Revised by A. G. Bloxam and Dr. S. J. Lewis. Pp. xii + 878. (London. J. and A. Churchill, 1913.) Price 21*s.* net.

The first edition of this well-known treatise appeared in 1867, and consisted of 630 pages which, as the preface of the present issue points out, sufficed to give a fuller account of the science of chemistry than the tenth edition can pretend to offer. The development of physical chemistry has rendered necessary a recasting of the first portion of the book. The periodic classification

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is followed more closely than in previous editions, and the inorganic portion of the volume rather than the organic has been developed in accordance with the increased attention which, the editors say, has been directed to inorganic chemistry of late years. Precise details from original memoirs, outside the scope of the ordinary text-book, have been included and will increase the value of the work for more advanced students.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Distance of the Visible Horizon.

THE subject of terrestrial refraction and its effect on the distance of the visible horizon, about which Mr. Backhouse inquires in NATURE of September 25, is very fully discussed in the second volume of Jordan's "Handbuch der Vermessungskunde." The formula there proved is

$$a = \sqrt{\frac{2r}{1-k}h}$$

where a = distance of visible horizon.
r = earth's radius.
k = coefficient of refraction (mean value 0·13).
h = height of observer.

This formula reduces to

Distance in statute miles $= 1{\cdot}312\sqrt{\text{height in feet}}$.

The subject is also discussed in Gillespie's "Higher Surveying," where, using a slightly different coefficient of refraction, the formula arrived at is very nearly the same, viz. :—

Distance in statute miles $= 1{\cdot}317\sqrt{\text{height in feet}}$.

It is easy to construct a table from either of these formulæ which will give the distance of the visible horizon at any height under average atmospheric conditions.

The method of reducing trigonometric heights described by Capt. Tizard, where the refraction-angle is taken at 5″ for each nautical mile of distance, is equivalent to using a refraction-coefficient of 0·18 in place of Jordan's 0·13. My own experience in the Red Sea and Gulf of Suez is that Jordan's value is tolerably correct near midday in winter and spring; this would imply that 4″ per nautical mile of distance is a nearer value than Capt. Tizard's 5″ under those conditions, and as a matter of fact the substitution of the lesser value leads to a rather better agreement for the height of Jebel Hooswah than that shown in Capt. Tizard's table.

Abnormalities of refraction, such as Capt. Tizard notes, are tolerably frequent over tropical seas, and one naturally avoids making measurements of altitude when the conditions are palpably abnormal. The variation of 18° in the altitude of the horizon in the Arctic regions, quoted by Capt. Tizard, is doubtless a misprint for 18′ or 18″; but in any case such a figure is meaningless unless the height of the observation-point is given.

It is not temperature *per se* which affects refraction, so much as the vertical temperature-gradient in the air; this varies very rapidly in the early morning hours, but becomes more steady about noon. I have found that at fair altitudes the refraction is in general wonderfully constant in the middle of the day, say between 11.30 a.m. and 3 p.m.; and by restricting observations for level to this time of the day I have obtained very much more concordant results than those quoted by Capt. Tizard. If the object is only visible in the early morning or late evening, an evening observation is much to be preferred to a morning one

The table given by Capt. Tizard is liable to give an exaggerated impression of the range of refraction. The differences of height found for the same point by his various observations probably depend not so much on variations in refraction, as on the roughness of the angular observations; in all cases except two, his depression-angles are only given to minutes, and a minute of arc at a distance of fifty-eight nautical miles subtends more than 100 ft. It is easy nowadays to measure the vertical angles well within 5″ of the truth, using only a 6-in. micrometer-theodolite; but perhaps in 1871 the instruments available were of a less accurate nature, and one must not be too critical of the results obtained. I would, however, venture to point out that it is incorrect to take the arithmetic mean of the heights from a number of observations at different distances when the least certain factor in the height (the correction to the height due to refraction) varies as the square of the distance; and it is scarcely scientific to correct for refraction to single seconds when the observations themselves are only taken to the nearest minute, or to calculate heights to four significant figures from distances given only to three.

JOHN BALL.

Survey Department, Cairo, October 2.

WITH reference to the remarks of Dr. John Ball, I am much obliged to him for directing my attention to Jordan's "Handbuch der Vermessungskunde" and Gillespie's "Higher Surveying," two works with which I was previously unacquainted.

The coefficient for refraction given by Jordan is the mean of a number of results by different observers in different countries, the originals varying from 0·105 to 0·167.

These results show that the refraction is a very variable quantity, and that the results inland are different from those near the sea. In Gillespie's work he shows how the refraction varies at different hours in the day on the coast of California (*a*) from a height of 57 metres, and (*b*) from a height of 1173 metres, being least near noon, and greatest in the morning and evening. From the height of 57 metres the coefficient varied from 0·14 to 0·10, whilst from the height of 1173 metres it varied from 0·09 to 0·06.

Gillespie publishes curves showing the results obtained. But he points out that the refraction is a very variable quantity, and it is doubtful whether the same curves would be obtained at all seasons at the same place. These are the very observations that are required.

It is quite true, as Dr. Ball points out, that if at Jebel Hooswah a refraction of 4 seconds instead of 5 per mile was used the results would be in closer accordance, but he does not appear to have seen that if a refraction of 6 seconds instead of 5 per mile was used for the Jebel Serbal observations they would be still more in accordance with each other. Therefore on different days and from different heights the results in the one case would be closer if the coefficient for refraction was decreased, and in the other if it was increased. Abnormal refractions are more common in high than in low latitudes; the greatest I have seen personally was in the Baltic Sea.

With reference to Dr. Ball's observations on the table given by me I reply as follows :—

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